

aastex

emulateapj5

natbib

(v)[†] $\lambda \quad \lambda\lambda \quad H\alpha \quad H\beta$ $B_T M_{B_T} M^* L^* \text{Mpc kpc pc km s}^{-1} \text{arcsec yr}^{-1} \text{mas yr}^{-1} r_{\text{fid}}$ $\text{pixel}^{-1} \text{pixel}^{-1} \text{erg s}^{-1} \text{erg cm}^{-2} \text{s}^{-1} \text{erg cm}^{-2} \text{s}^{-1} \text{arcsec}^{-2} \text{erg cm}^{-2} \text{s}^{-1} \text{arcmin}^{-2} \text{erg cm}^{-2} \text{s}^{-1} \text{sr}^{-1} \text{count s}^{-1} \text{count s}^{-1} \text{arcmin}^{-2}$ *e.g. i.e. et al.* $\text{erg cm}^{-2} \text{s}^{-1}$

H2 [S2] [O3]

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SN 1006 Optical Proper Motions, etc. Winkler, Gupta, & Long

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The SN 1006 Remnant: Optical Proper Motions, Deep Imaging, Distance, and Brightness at Maximum

P. Frank Winkler¹, Gaurav Gupta² Department of Physics, Middlebury College, Middlebury, VT 05753winkler@middlebury.eduKnox S. Long¹ Space Telescope Science Institute, Baltimore MD 21218

¹Visiting Astronomer, Cerro Tololo Inter-American Observatory. CTIO is operated by AURA, Inc. under contract to the National Science Foundation. ²Present Address: Department of Mechanical and Aerospace Engineering, Cornell University, Ithaca, NY 14853

abstract We report the first measurement of proper motions in the SN 1006 remnant (G327.6+14.6) based entirely on digital images. CCD images from three epochs spanning a period of 11 years are used: 1987 from Las Campanas, and 1991 and 1998 from CTIO. The filaments in SN 1006 are non-radiative, appearing only in the Balmer lines of hydrogen. Delicate filaments—probably thin sheets seen in projection—delineate the shock front along the northwest rim of the remnant. We use the center of curvature of the filaments to define a convenient geometry, and integrate along short segments to obtain one-dimensional profiles. These remain unchanged, within seeing and statistical errors, from one epoch to another. Measuring the shift in a direction perpendicular to the filaments, we obtain proper motions of 280 ± 8 along the entire length where the filaments are well defined, with little systematic variation along the filaments. In addition to the measurements of the well-defined filaments in the NW of SN 1006, we also report very deep imaging observations of the entire remnant that clearly show very faint emission surrounding almost the entire shell, as well as some diffuse emission regions in the (projected) interior.

Combining the proper motion measurement with a recent measurement of the shock velocity based on spectra of the same filaments by Ghavamian leads to a distance of 2.17 ± 0.08 kpc to SN 1006. Several lines of argument suggest that SN 1006 was a Type Ia event, so the improved distance measurement can be combined with the peak luminosity for SNe Ia, as recently determined for events in galaxies with Cepheid-based distances, to calculate the apparent brightness of the spectacular event that drew wide attention in the eleventh century. The result, $V_{\text{max}} = -7.5 \pm 0.4$, lies squarely in the middle of the wide range of estimates based on the historical observations.